INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 4, Issue 7, (2014) E-ISSN: 2222-6990

The Speed of Adoption of Technology and Time Punctuality: The Case of Internet Usage

William R. DiPietro
Professor of Economics, Daemen College
E-mail: wdipietr@daemen.edu

DOI Link: http://dx.doi.org/10.6007/IJARBSS/v4-i7/986

Published Date: 05 July 2014

Abstract

While various researchers have considered economic, demographic, regulatory, infrastructure, and other factors as potential determinants of diffusion, less attention has been given to the potential role that culture plays. This is unfortunate, because cultural factors may not just represent proximate causes for differences in technological diffusion across countries, but they may also be the deep-seeded underlying structural powers that ultimately determine the technological adoption behavior of countries. This paper uses cross country regression analysis to see whether the cultural trait of time punctuality is consequential for the rate of internet diffusion over the period 1990 to 2010. The results are consistent with the notion that time punctuality is important and favorable for the diffusion of Internet usage.

Every country wants its standard of living to rise, and the major instrument for increasing income per capita is technological change and innovation. Now, the extent that new technology has an impact on productivity and people's lives depends on the degree, and on the speed, that it is put into actual use and practice. The extent and speed of technological adoption is important for productivity not only because it affects productivity directly in the short run, but just as important, because indirectly it affects long time productivity through its positive feedback effect on the prevailing rate of technological change and innovation. A society that readily adopts new technology provides an environment favorable for innovation, while a society reluctant or unwilling to adopt new technologies, or to adopt them very slowly, gives little incentive for new invention and new technological development.

Culture and cultural traits are almost certain to have an impact on the rate of adoption of technology. For instance, the unbounded taste for novelty in American culture is surely a powerful force with regard to the speed of adoption of technology in America society. Historically, the lack of adoption and diffusion of steam technology in Roman times can probably be attributed, partially, if not completely, to the culture of slavery in Rome.

One important cultural trait that varies substantially across countries is time punctuality. Some societies require things to be done exactly on time, while in other societies; it is rare, uncommon, and unexpected for any functions to start on time. Time punctuality is highly

interwoven with the value societies place on personal relationships. Societies with less time consciousness place higher values on personal relationships. Individuals within these societies are willing to expend more time and resources on the formation and the development of personal relationships at the expense of time punctuality. In general, one might say, that for these societies, the medieval notion of friendship and loyalty dominate over the abstract notion of time in the lives of people.

The major objective of this paper is formally to empirically test the hypothesis that time punctuality is important for the speed of internet diffusion.

The paper is divided into five parts. The first part reviews a little of the current literature on Internet diffusion. The second presents a simple model of the rate of technological diffusion that spotlights time punctuality as a key determinant. The third section provides information on the sources of the variables for the empirical research. The fourth shows the results of regressions to test whether time punctuality matters for speed of diffusion of the internet across countries. The fifth section concludes.

Literature

Chinn and Fairlie (2004) construct a panel of one hundred sixty one countries from 1999 to 2001, and consider a whole set of economic variables, demographic variables and infrastructure variables along with measures of telecommunications pricing and regulatory quality, to look separately at the potential determinants of personal computer penetration and of internet penetration (Chinn & Fairlie, 2004). In terms of internet penetration, they find that income per capita, regulatory quality, and age dependency matter for internet usage, but, surprisingly, that pricing of telecommunications access and education are not statistically relevant.

Kiishki and Pohjola (2001) look at cross country diffusion of the internet employing a Gompertz's model of diffusion for the years 1995-2000. Whether they use a sample restricted to OECD countries, or a more comprehensive sample that includes non-industrial countries, they consistently find that GDP per capita and internet access cost are statistically relevant, with GDP per capita having a positive effect, and internet access cost a negative effect on diffusion. With regard to the impact of education, they find mixed results. Education has no significant effect in their restricted OECD sample, but a positive effect in their larger sample of countries. In addition, and especially germane to the present study, they find, in their smaller OECD sample, that regional dummies matter for Internet diffusion, suggesting to the authors that cultural factors may also need to be considered when explaining differences in the diffusion of internet technology across countries.

Using a data set consisting of one hundred eighteen countries for the period 1997 through 2001, Guillen and Suarez (2005), in their regression analysis, test to see whether the sociopolitical characteristics of world-system status, competition, privatization, democracy, and cosmopolitanism matter for internet diffusion, after adjusting for the level of development, telecommunications infrastructure, cost of Internet access, and education. In general, they find that, in addition to the traditional economic variables, the various sociopolitical variables are statistically relevant in explaining internet usage (Guillen and Suarez 20005).

Dewan, Ganley, and Kraemer (2005) investigate the drivers of mainframe, personal computers, and internet penetration using panel data for forty countries from 1985 through 2001). They use both per capita and per GDP measures as indexes for the three different kinds of information technology penetration, which they consider to be examples of diffusion of three distinct generations of information systems technology. In their investigation, they

look to see how the effect of various explanatory variables differs for different forms of technology, and, for each form of technology, how the effect of individual explanatory variables varies with the extent of technological penetration. Overall, their regression analysis indicates that GDP per capita, education, assess cost, urbanization and the size of the trade sector are important determinants of the various forms of information technology penetration. Their quantile regression analysis suggests that for internet penetration, greater internet penetration leads to a stronger relationship between internet penetration and GDP per capita, so that, the effect of the same dollar increase in GDP per capita in a country with higher internet penetration will increase internet penetration more than for a country starting with lower internet penetration (Dewan et al., 2005).

Besides providing a detailed survey of the literature on the empirical research explaining the digital divide, Billon, Lera-Lopez and Marco (2010) create a digitalization index for six different types of information and communications technology employing factor analysis, and separately regress the digitalization index on a large number of explanatory variables on low digitalization, middle digitalization, and high digitalization countries. They find that GDP per capita is statistically significant for each of the three groups, that infrastructure matters for high and low digitalization groups, that the age distribution of the population is important for high and middle digitalization groups, but not for low digitalization countries, that education is only statistically relevant for the middle digitalization group, that regulatory quality only matters for highly digitalized countries, and surprisingly, that internet price is not statistically relevant for any of the groups. In addition, they use canonical correlation analysis and discover that different patterns of digitalization occur for different groups of countries (Billon et al., 2010).

Zahir, Dobing and Hunter (2002) qualitatively examine and compare the content of twenty six different national internet web portal sites to see what they have and what they do not have with regard to Hofstede's cultural dimensions of individualism-collectivism, power-distance, uncertainty-avoidance, masculinity-femininity, and long-term versus short-term orientation. In general, they find that the content of country portal differs on the basis of the cultural dimensions that a country possesses (Zahir et al., 2002).

In the area of broadband adoption, a few authors have considered one cultural factor, uncertainty avoidance, as a potential factor for explaining broadband diffusion in their regression analysis. In their regression of fixed broadband penetration on a large number of regressors, Jakopin and Klein (2011) find several variables, economic prosperity, service sector activity, personal computer penetration, and regulatory quality, to be statistically significant drivers of broadband development, but, although uncertainty avoidance is included as a regressor, it does not prove to be statistically relevant (Jakopin & Klein, 2011).

Kim and Jeong (2010) discuss the diffusion of the internet in a single country, South Korea. They attribute the rapid diffusion of the Internet in South Korea to several factors. These include strong government support, low subscription fees, high urban density, perceived usefulness and value, and, most important for the present study, Korean cultural characteristics, such as the desire to do things in a hurry.

Method

This paper presents a model of internet diffusion with the cultural trait of time punctuality as argument. The model consists of a single equation with an associated partial derivative. The equation is as follows.

$$1.\ D = f(T, O)\ \delta D/\delta T > 0$$

In the equation, D represents the extent of Internet diffusion over a period of time, T stands for time punctuality, and O is a set of control variables. In words, the model simply states that the rate of internet diffusion is positively related to the cultural trait of time punctuality after adjusting for other variables that are commonly employed to explain internet usage.

Time punctuality is likely to be positively related to the rate of adoption of technology for a number of reasons.

First, it is often the case that the major purpose or even the whole purpose of a new technology is to save time. Those who have small time consciousness have little desire or need for any new time saving technology. On the other hand, people who desire to save time, people who are highly time conscious, are, for obvious reasons, going to be more likely to adopt, and to adopt quickly, and a new time saving technology.

Second, a major characteristic of new technology is that it disrupts the existing pattern of social relationships, often requiring a whole new set of social relationships. In some cases, the former ways of relating can no longer exist or can only exist in a much reduced form in the presence of an advance in a new kind of technology. This is not favorable for those who dislike change, and who like things to move slow, and want their existing nexus of personal relationships to remain stable and intact.

Third, new technology often requires some kind of new market product to serve as an intermediate between people thereby replacing direct personal relationships between people with indirect relationships through the use of the new product. That is to say, product mediated relationships are substituted for one-on-one direct personal contact between people. Product purchases now become required to sustain relations between people that before did not need them, but now, cannot exist without the use of the product. For instance, the introduction of the telephone requires a telephone for phone conversations, and replaces personal interaction with interaction between people with the phone acting as the intermediary. With regard to the new Internet technology itself, it requires people to purchase a computer and to buy on-line internet services, and it is most certainly causing people to relate in different ways than before.

Three control variables are considered in this study. They are the level of economic development, the amount of education, and the extent of democracy. Consistent with the theory developed in previous research in the field, each of these variables is expected to be positively related to internet diffusion.

A highly developed economy has the infrastructure required to ready adoption a new technology and provides individuals within the society with a greater ability to obtain access to any new technology. Greater education provides the human capital for individuals to readily adopt, and, the desire to adopt, a new technology. Greater democracy mitigates the potential totalitarian control and suppression of the development and expression of a new technology.

Sources for the Variables

The gauge of the speed of country's adoption to the internet is country's internet usage per hundred persons for the year 2010 minus the country's internet usage per hundred persons for the year 1990. The data on the internet usage per hundred persons for various countries for the two different years comes from the World Bank (World Bank, 2013).

The measure of time punctuality is constructed by the author himself by using the views of time category for countries around the world of Culture Crossing's internet site (Culture

Crossing, 2013). Looking at this category, countries are rated from one to four by the author with higher values indicating greater time punctuality.

The index for the level of economic development is the index that is commonly employed as a gauge of economic development, real GDP per capita. The specific measure used here is Gross domestic product per capita for 2005 in real 2000 dollars. The data comes from the World Bank (World Bank, 2011).

The democracy index of the economist magazine for 2008 is used to try to capture the extent of democracy (The Economist, 2008). The democracy index ranges from zero to ten with higher values indicating greater democracy.

The measure of the amount of education is the average (mean) number of years of education received by people ages twenty-five years and older for the year 2010. The source for the numbers is the United Nations (United Nations, 2013).

The Cross Country Empirical Results

Table I shows the results of cross country regressions of the rate of adoption to the Internet regressed on time punctuality, and regressed on time punctuality adjusting for other variables. In all regressions, the speed of adoption to the internet is measured by the difference in Internet users per one hundred people in 2010 and the internet users per hundred people in 1990.

TABLE I
CROSS COUNTRY REGRESSIONS SPEED OF ADOPTION TO THE INTERNET ON TIME PUNCTUALITY AND
OTHER VARIABLES

	(1)	(2)	(3)	(4)
CONSTANT	-13.768 (-2.842) *	3.506 (.87)	-14.137 (-3.57) *	-18.558 (-4.24) *
PUNCTUALITY	22.498 (10.55) *	9.13) (4.37) *	6.418 (3.43) *	4.548 (2.36) **
DEVELOPMENT		.00162 (10.20) *	.00122 (8.85) *	.00116 (8.31) *
EDUCATION			3.605 (8.23) *	3.670 (8.14) *
DEMOCRACY				1.465 (2.23) **
RSQ	.446	.710	.831	.853
N	140	134	120	113

The table is constructed with the first column listing the explanatory variables and the remaining columns, columns two through five, showing the results of individual regression runs. The estimated coefficient for any variable that enters an equation is shown as the top value in the body of the table corresponding to the appropriate row and column in the table. In parentheses, underneath the estimated coefficients, are the individual t-statistics. The row labeled RSQ shows the r-squared values for the

regression equations, and the last row, N, the number of observations or number of countries entering an equation.

The table contains the results for four regressions. The first reports the outcome of the speed of adoption to the internet on time punctuality alone. The second shows the effect of time punctuality after adjusting for the after adjusting for three variables, the level of economic development, the extent of education, and the amount of democracy.

The results are very consistent with the notion that the cultural trait of time punctuality matters for the rate of adoption of Internet technology, and by extension, to other forms of technology. Time punctuality is positive and significant at the one percent level of significance or better in the first three equations of table I, and significant at the five per level or better in the fourth equation. On its own, time punctuality explains over forty four percent of the cross country variation in the speed of technological diffusion of internet usage in a sample of one hundred forty countries (equation (1)).

Each of the other variables is also statistically important whenever they appear in an equation, and, when they appear in an equation, they have their theoretically anticipated signs. The level of economic development is positive and significant at the one percent level or better in the three equations that it enters (equation (2), (3), & (4)). The human capita variable, the amount of education, is positive and significant at the one percent level in the two equations that it enters (equation (3) & (4)). Finally, the extent of democracy is positive and significant in the single equation in which it enters (equation (4)). Together, as a group, the four variables explain over eighty five percent of the cross country variation in the speed of internet adoption in a sample consisting of one hundred thirteen countries (equation (4))level of economic development. The third considers the impact of time punctuality after adjusting for both the level of economic development and the extent of education. Finally, the fourth regression looks at the effect of time punctuality on the speed of internet adoption.

CONCLUSION

The cross country regressions provide support for the hypothesis that the speed of technological penetration in the case of the internet is positively related to time punctuality. Whether the rate of penetration of internet technology is regressed alone on time punctuality, or used in combination with one or more of the other variables commonly used by previous researchers, time punctuality proves to be a significant determinant of the speed of diffusion of internet technology.

If the results for the study on the speed of the spread of internet technology can be generalized to the speed of spread of any new technology, and there is no real reason for assuming otherwise, then. changes in the cultural trait of time punctuality needs to be addressed in order to enhance the rate of improvement of the standard of living of society brought about through the adoption of new technology.

However, changing any cultural trait is not a small undertaking but a long term arduous task wrought with enormous difficulties. Changing a society from one that has little consideration for time punctuality to one that is highly time conscious is likely to encounter a lot of resistance. When you are talking about cultural modifications, it means changing the essence, the heart, the very identity of a people or society. Naturally, education, and the socialization process are the major mechanisms for achieving such an objective. However, it is not education itself, the amount of education, or socialization itself, the degree of socialization, but the very controversial content of education (what we are teaching) and content of socialization (what we are socializing people to be) that matters.

References

Billon, M., Lera-Lopez, F. & Marco, R. (2010). Differences in digitalization levels: A multivariate analysis studying the global digital divide. Review of World Economics, 146, 39-73. Retrieved from http://peer.ccsd.cnrs.fr/docs/00/56/36/02/PDF/PEER stage2 10.1007%252Fs10290-009-0045-y.pdf

Chinn, M. D. & Fairlie, R.W. (2004). The determinants of the global digital divide: A cross-country analysis of computer and internet penetration. (Working Paper No. 10686). Retrieved from National Bureau of Economic Research website: http://www.nber.org/papers/w10686

Culture Crossing. A community built guide to cross-cultural etiquette and understanding. Retrieved February 10, 2013 from http://www.culturecrossing.net/index.php

Dewan, S., D., Ganley, D., & Kraemer, K.L. (2005). Across the digital divide: A cross-country multi-technology analysis of the determinants of IT penetration. Journal of the Association for Information Systems, 6(12), 409-432.

Guillen, M.F. & Suarez, S.L. (2005). Explaining the global digital divide: Economic, political and sociological drivers of cross-national internet use. Social Forces, 84(2), 681-708. Retrieved from: http://www.socsci.umn.edu/mggen/guillen sf 05.pdf

Jakopin, N.M. & Klein, A. (2011). Determinants of broadband internet access take-up: Country level drivers. Info, 13(5), 29-47.

Kiiski, S. & Pohjola, M. (2001). Cross-country diffusion of the internet. World Institute for Development Economics, WIDER discussion Papers. (Working Paper No. 2001/11). Retrieved April 28, 2013 from http://www.econstoreu/bitstream/10419/52913/1/333285727.pdf

Kim, A.E. & Jeong, M.K. (2010). Technological diffusion, internet use and digital divide in South Korea. Korea Observer, 41(1), 31-52.

The economist intelligence unit's democracy index. (2008). The Economist. Retrieved from http://graphics.eiu.com/PDF/Democracy%20Index%202008.pdf

International human development indicators. Retrieved May 1, 2013 from United Nations website: http://hdrstats.undp.org/en/indicators/103006 .html

World economic indicators. (2011) Retrieved May20, 2013 from World Bank website: http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=worlddevelopment-indicators

Zahir, S., Dobing, B. & Hunter,M.G. (2002). Cross-cultural dimensions of internet portals. Internet Research, 12(3), 210-220.